EFFECT OF PEER INSTRUCTIONAL STRATEGY ON ACADEMIC ACHIEVEMENT OF SENIOR SECONDARY SCHOOL BIOLOGY STUDENTS IN ENUGU EDUCATION ZONE

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ABSTRACT
This research investigated the effect of Peer Instructional Strategy (PIS) on the academic achievement of Secondary School Biology Students in Enugu Education zone of Enugu State. Two research questions and two hypotheses guided the study. The study employed non-equivalent control group design involving 528 (227 male and 301 female) SSII Biology students drawn from six randomly selected co-educational schools out of the ten secondary schools in Enugu Education zone that met the inclusion criteria. Two intact classes from each of the six schools (twelve classes) were randomly assigned to either Peer Instructional Strategy and Expository Method group by balloting. Using the assigned method for each group, trained research assistants taught the same content to the respective groups, simultaneously. The instrument for the study was a researcher-made Biology Achievement Test (BAT), validated by three experts, and pilot tested. Pearson Product Moment Correlation Coefficient was used to carry out test-retest reliability of the instrument, r = 0.74. The BAT was administered (pretest) before the interventions, after 4 weeks long intervention (post-test).. To avoid distribution bias; scores of forty-four students who completed the study procedures and took all the appropriate tests were randomly drawn from each of the twelve intact classes through software randomization. The scores were processed for data analysis. Statistical tools of mean and standard deviation were used to answer the research questions while Analysis of Variance was used to test the hypotheses at .05 level of significance. The researcher concluded that PIS improves the academic achievement and of both male and female secondary school Biology students better than the expository Method.

Keywords and Phrases: Peer Instruction, Achievement and Biology.

INTRODUCTION
Biology is the study of all living forms, plants and animals; including man, as individuals and as inter dependent entities. Biology demonstrates the absolute dependence of man, on all others forms of life. Life is very important because it is when one is alive that one can carry out day to day activities. Some of the rationale born in mind while studying biology include: understanding of oneself and one's environment, appreciation of nature as well as

population control (Kalra, 2008). Accordingly, Nwachukwu (2015) opined that biology is concerned with the study of life of organism, their behaviours, habits, distributions, origin and what they do. Biology principles are applied in agriculture, pharmaceutical industries as well as in the field of medicine. The knowledge of biology also helps us to know and understand sex determination and linkage, natural birth control and crime. Based on the importance of biology, a sound theoretical and practical knowledge and understanding of biological concepts and principles are necessary for the well-being and technological advancement of a country like Nigeria (Offor, 2004). To achieve greater achievement goals in secondary school Biology, Biologists and Biology educators have concerned themselves with continuous search for better and effective methods, approach, strategies and models of teaching and learning that can make the study of Biology more meaningful to the learner and thus enhance high achievement of the facts, since lecture method is not student-centred (Ugwu, 2014).

Many innovative strategies such as Peer Instructional strategy have been found to improve achievement; they are very useful today in science subjects' delivery by teachers. Peer Instructional strategy is designed in such a way that students solve problems by their own mental processes. Peer instruction involves students preparing to learn outside the classroom by doing pre-class readings and answering questions about those reading using another method called "just in-time teaching" This is when the student pair with his/her peer to discuss a concept to each other before the final answer. The peer instruction questioning procedures outlined by Mazur (2014) follows this sequence:

> Instructor poses questions based on students' responses to their pre-class reading, (ii) Students commit to an individual answer, (iii) Students reflect on the questions, (iv) Instructor review students' responses, (v) Students discuss their thinking and answers with their peers, (vi) The instructor again review their responses and decides whether more explanations is needed before moving on to the next concept.

It was found by Mazur (2015) that this peer instructional strategy increased achievement and retention in physics in United State of American. The present work aims to find out, if peer instructional strategy will also increase achievement in secondary school biology students in Enugu Education Zone, Nigeria.

It has become apparent that academic achievement could be influenced by teaching methods among other factors. Hence, learner-centred approach has come to spotlight worldwide (Blumberg, 2008). Although learner-entered approach does not employ a single teaching method, the emphasis is on shifting the role of the instructors from givers of information to facilitating students' learning. Among others, this approach includes expository method and peer instructional strategy. Unlike the peer instructional strategy, the expository method typically focuses on a real world, complex problems and their solution, using role-playing exercise, problem-based activities, case studies and participation in virtual communities of practice (Lombardi and Oblinger, 2007). Within its

own merits, it has disadvantages of slow process of teaching, time consuming, uncooperative among peers and non-interactive learning with inadequate supervision by the teacher especially in a large class (Mims, 2003). The thrust of this work, therefore, is ascertaining the effect of peer instructional strategy to academic achievement of biology students in comparison with the expository method of learning. Many studies carried out so far blame the state of affairs on the ineffective teaching methods adopted by the teachers of Biology in Nigerian secondary schools. Biology teachers often adopt lecture, discussion, storytelling, individualized teaching methods etc. These methods are non-inspiring and largely ineffective, didactic, dull and non-result oriented. Many researchers in science education do not recommend their use in the senior secondary science teaching. There have been several researches on which method is better among traditional based and teacher centred instructional strategies such as peer instruction. That notwithstanding, this research is of the opinion that Peer Instructional Strategy is much better than the traditional based method despite the continued debate. Consequently, the exact comparative impact of the two instructional strategies on students' achievement in Biology is yet to be established. Although evidence exists in favor of the peer instructional strategy of teaching, it cannot be successfully sustained without subjecting it to thorough empirical screening. The researchers in Biology and other science subjects are therefore challenged with the responsibility of verifying the effect of such instructional strategy on the students' achievement in Biology. The question then is: would the peer instructional strategy of teaching biology bring about better achievement in the subject at the secondary school level

PURPOSE OF THE STUDY

The main purpose of this study is to investigate the effect of peer instructional strategy on the academic achievement of secondary school Biology students. Specifically, the study seeks to determine: (a) The effect of Peer Instructional Strategy on secondary school students' academic achievement in Biology when compared with Expository Method. (b) The difference in the mean achievement scores of male and female students taught with Peer Instructional Strategy.

RESEARCH QUESTIONS

To provide direction for this study, the following questions were formulated:

1. What is the mean difference between the academic achievement of students taught with Peer Instructional Strategies and their counterparts taught with the Expository Method?
2. What is the mean difference between the academic achievement of male and female students taught with Peer Instructional Strategies?

HYPOTHESES

The study was guided by the following hypotheses tested at 0.05 probability level.

Ho_1: There is significant difference in the mean academic achievement of students taught with Peer Instructional Strategies when compared with Expository Method.

Ho_2: There is significant difference in the mean academic achievement between male and female students taught with Peer Instructional Strategies.

METHOD

The study is a quasi-experimental research; specifically, Pre-Test-Post-Test Non-equivalent Groups research design was employed. The reason for using non-equivalent groups design is because the intact classes that were used have varying number of students. For this study, two levels of treatment conditions were used. These are Peer Instruction Strategy (PIS) and Expository method (EM). The PIS was used on one treatment group whereas, the EM was used for the control group. In terms of content basic instructional objectives and mode of evaluation, the PIS is identical to EM. The major difference is in the instructional activities.

The pre-test was administered to all the classes (both experimental and control) at the same time to avoid others gaining advantage if the test were administered at different dates and times. The sample used for the study consisted of 528 (227 males and 301 females) SSII Biology students drawn from the 10 secondary schools in Enugu Education Zone that met the inclusion criteria for this study. Six co-educational schools with at least two distinct intact classes (2 each) from the three local government areas that made up the zone were randomly selected through balloting without replacement. The name of all the qualified schools in each local government area (Appendix A) was written in pieces of papers and concealed in brown envelops and thoroughly mixed in three separate black paper bags. An independent assistant was invited to select two schools from each of the bags without replacement. Two intact SSII classes in each of the selected schools was purposely selected and randomized (through balloting) into peer instructional strategy (PIS) group and expository method (EM) group respectively. This was carried out by blindfolding the class prefects from each class and directing them to choose from either PIS or EM, written in two pieces of paper concealed in a black paper bag. All the registered male and female SSII biology students in each of the intact classes participated in the study. The minimum number of students in each intact class was 45. For the sake of homogeneity of study sample, 44 students who completed the pretest, treatment sessions, post test and retention test were randomly selected from each of the two intact classes that were designated for this study across the six schools. Their serial numbers was inputted into SPSS software and a computerized generation of random numbers was used to select forty-four students per an intact class (44 X 2 X 6 = 528). The instrument that was used for data collection is the biology achievement test (BAT), developed by the researcher. The test items were of the same format in arrangement, plan and design with that of senior secondary schools certificate examination (SSCE) questions. This is because the

researcher was of the opinion that the SSII students at this stage should be exposed to such level of questions since they would soon enter their final year class, while some of them attempts SSCE (WAEC and NECO) at this level. The instrument was designed to explore the immediate post intervention achievement and the retention level of the learners in biology. The instrument BAT was constructed based on table of specification (Appendix B). The BAT consists of a set of sixty (60) multiple choice questions. Among the sixty items, fifty (50) questions was randomly selected from the number which survived validation exercise and was used to collect the data for the study. Each item in the instrument contains five (5) options A-E from which one option represents the correct answer. This instrument was used for pre-test after which, the same test was re-seriated in numbers and re-arranged by options and administered for post-test and retention test. A copy of the pre-test, post-test and retention test versions of the instrument was supplied in Appendix C. The BAT, research questions and hypotheses was given to three experts for face and content validity. The experts was drawn from the Department of Science and Computer Education, Enugu State University of Science and Technology (ESUT)- one from Measurement and Evaluation option and two from Biology. Their comments and critical appraisal led to the elimination of the poor items and correction of the wrongly spelt words (see the validators' comments on Appendix D). The content validity of the instrument BAT was done using the selected topics for the study. The content areas was chosen and weighed based on the period of coverage. The test blue print was used to ensure content validity of the instrument. At the end of the validation, correction were reflected to ensure that the instrument serve the purpose for this design. A final clean copy of the instrument was printed and the fifty (50) items that survived the validation exercise was subjected to reliability test. The reliability of BAT was established using test-retest on fifty (50) biology students of SSII at Urban Secondary School, Oji River in Awgu Educational Zone of Enugu State. These students were similar to those selected for the study. BAT was administered to the selected students twice at the interval of two weeks. A pair-wise test-retest correlation of the scores was carried out. The researcher then used the Pearson's Product Moment Correlation Coefficient (r) to compute the reliability co-efficient of BAT. The reliability of BAT was $r = 0.72$. That means that there was a strong positive correlation between the first and second trial scores, therefore the instrument was reliable. This method is appropriate for determining the test-retest reliability index for parametric set of (continuous variable) data measured on ratio scale (0-100%). Kuder-Richardson 20 or 21 is only applicable to test the internal consistency of a dichotomous (yes/no) response type of instrument, measured on binary (1/0) nominal scale; or test-scores that have undergone binary conversion. Data was collected trice using pre-test, post-test and retention test versions of BAT following the test administration schedule shown in table 2. The researcher travelled to the schools involved within two days before the tests were taken and gave the research assistants the appropriate test copies according to the nominal roll of each school. The question papers was concealed on a brown envelope and the research assistant was instructed not to open it until the test time, which was taken simultaneously

across the schools by 10:00am at the same day. The students were instructed to circle the correct answers and submit under strict invigilation of the research assistants. The time allowed for the test was one and a half hours (1:30min). After which the papers were collected, concealed in the envelope. The researcher collected the attendance sheet and the scripts, marked them and collated the data for analysis. Mean, standard deviation and mean-difference (descriptive statistics) were used in answering the research questions while the null-hypotheses (H_0) 2 – 5 and 7 – 10 were tested using the independent samples t-test. H_0 1 and 6 were tested using Analysis of Variance (ANOVA) with Turkey post hoc test and Bonferroni adjustment. Level of significance was set at $p \leq 0.05$.Level of significance was set at $p \leq 0.05$. For all the null-hypothesis; if calculated p-value on the ANOVA or t-test is equal to or less than the critical value at 0. 05, the null hypothesis was not rejected or accepted since the accepted side of the study used Quasi-experimented design, ANOVA would have been the best statistical tool or testing the hypothesis. ANOVA & t-test are not appropriate statistical tools for testing hypotheses in this study.

RESULTS

Research Question 1

What is the mean difference between the academic achievement of students taught with Peer Instructional Strategies and their counterparts taught with the Expository Method?

Table 1: ANOVA of differences in academic achievement at pretest, post-test EM and PIS

ANOVA variables	Degree of freedom	Mean square	F-value	P-value
Between groups	2	3222.409	40.743	0.001*
Within groups	1053	79.080		
Turkey Post Hoc Test		**Mean difference**		**P-value**
Post test EM vs. Pretest		1.43		0.91
Post test PIS vs. Pretest		6.10		0.001*
Post test PIS vs. Post test EM		4.67		0.001*

EM = Expository Method. PIS = Peer Instructional Strategy. (*) = significant p-value.

The result presented in table 1 shows that there was a significant difference in mean academic achievement of biology students taught with PIS, and EM relative to their pretest scores.

Hypothesis 1

There is no significant difference in the mean academic achievement of students taught with Peer Instructional Strategies when compared with Expository Method.

Table 2: ANOVA of differences in academic achievement at pretest, post-test EM and PIS

ANOVA variables	**Degree of freedom**	**Mean square**	**F-value**	**P-value**
Between groups	2	3222.409	40.743	0.001*
Within groups	1053	79.080		
		Mean difference		**P-value**
Turkey Post Hoc Test				
Post test EM vs. Pretest		1.43		0.91
Post test PIS vs. Pretest		6.10		0.001*
Post test PIS vs. Post test EM		4.67		0.001*

EM = Expository Method. PIS = Peer Instructional Strategy. (*) = significant p-value.

The ANOVA result showed that a statistically significant difference exists in at least one of the pairs. The Turkey post hoc test with Bonferroni adjustment showed that the students that was taught with PIS had a higher mean achievement scores than the pretest score with 6.10%, p = 0.001. Most importantly, the mean score of PIS group was significantly better than that of EM group by 4.67%, p = 001. Although the score of the students in EM group was higher than pretest by 1.43%, the outcome was not statistically significant p = 0.96.

Table 2 showed that there was a significant difference in the mean academic achievement of biology students taught with PIS relative to their counterparts in EM group and the pretest scores (F (2) = 40.743, p = 0.001). The calculated p-value (0.001) is less than the set significant level ($p \leq 0.05$), therefore, the researcher rejects the null hypothesis. This implies that there is a significant difference in the mean academic achievement of students taught with Peer Instructional Strategies when compared with Expository Method and the pretest.

Research Question 2
What is the mean difference between the academic achievement of male and female students taught with Peer Instructional Strategies?

Table 3: Academic achievement of male and female students taught with PIS

Parameter (%)	N	Mean ± S.D	Mean Diff.	Net Mean Diff.	t-value	p-value
Males PIS Pre-test	114	60.16 ± 9.11	6.55			
Male PIS Post-test	114	66.71 ± 8.96		0.42	0.568	0.571
Female PIS Pre-test	150	59.30 ± 9.14	6.97			
Female PIS Post-test	150	66.27± 8.18				

EM = Expository Method. PIS = Peer Instructional Strategy. (*) = significant p-value.

The result presented in table 3 shows the mean academic achievement of the male and female students that were taught with PIS. Relative to baseline (Pre-test), the males had an improvement of 6.55% compared with the female that had an improvement of 6.97%, the net mean difference was 0.42%. 2. There was no significant difference in the mean academic achievement between male and female biology students taught with Peer Instructional Strategies or Expository Method.

Hypothesis 2
There will be no significant difference in the mean academic achievement between male and female students taught with Peer Instructional Strategies.

Table 4: Academic achievement of male and female students taught with PIS

Parameter (%)	N	Mean ± S.D	Mean Diff.	Net Mean Diff.	t-value	p-value
Males PIS Pre-test	114	60.16 ± 9.11	6.55			
Male PIS Post-test	114	66.71 ± 8.96		0.42	0.568	0.571
Female PIS Pre-test	150	59.30 ± 9.14	6.97			
Female PIS Post-test	150	66.27± 8.18				

EM = Expository Method. PIS = Peer Instructional Strategy. (*) = significant p-value.

The t-test result in table 4 showed that there was no significant difference in the mean achievement of male and female students taught with PIS ($t = 0.568$, $p = 0.571$). The calculated p-value (0.571) was greater than the set significant level ($p \leq 0.05$), therefore, the null hypothesis is not rejected. It means that there is no gender difference within the PIS group and that sex of the students is not a significant covariate in the result presented in table 4.

DISCUSSION OF FINDINGS

The findings of this study showed that with regard to academic achievement of Senior Secondary School students. PIS group significantly performed better than EM group, relative to the pretest scores of both group. The post-test (pair-wise comparison) showed that the students that were taught with PIS had a higher mean achievement than those of EM group. This finding was in agreement with other studies (Turpen and Fukeistein, 2015, Mazor, 2015) and found PIS to be superior to EM in terms of students' academic achievement. Hoffer, Radke and Lord (1992) stated that practical experiences that utilize hand-on-inquiry have been regarded as one of the most effective method of learning science and the development of higher order thinking skills necessary for biology. Similarly, Akale and Usman (1993) investigated the effect of intensive peer instruction approach on (JSII) students' achievement in integrated science, in Zaria local Government Area of Kaduna State. They assigned students randomly to experimental and control groups. The instrument used for the study was achievement test comprising of 30 multiple choice items, 10 short answer items, 5 essay questions and 30 practical activities. T-test and ANCOVA were used to analyze the data, and the findings revealed among other things, that students in experimental group achieve higher than their counterparts in control group who were not exposed to peer instruction approach.

CONCLUSION

The following conclusion was made based on the result of the findings

1. Peer Instructional Strategy improves the academic achievement of both male and female secondary school biology students better than the expository method.
2. Peer Instructional Strategy improves the academic achievement and level of retention of both male and female secondary school biology students better than the expository method.

RECOMMENDATIONS

Based on the findings, the following recommendations were made:

1. Secondary school biology teachers should adopt PIS teaching method in other to enhance learning and improve retention of knowledge among their students.
2. Publisher should try and organize their test books in a way that it can easily be used by the students for self-discovery and peer discussions in other to enhance implementation of PIS.

3. Curriculum developers should consider the concept of PIS during content brake down in other to make room for PIS.
4. Stake holders of Education should organize seminars and workshops to train teachers on the use of PIS for effective instruction and improved achievement in Biology.

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